WHAT IS CLAIMED IS:

1. An article comprising an array of microcubes, at least one of said microcubes being non-hexagonal, such that for every plane in space there are two adjacent microcubes for which at the place of the adjacency none of the face edges is parallel to that plane.

2. The article of claim 1 wherein said array is retroreflective.

3. The article of claim 2 wherein said article comprises retroreflective sheeting.

4. The article of claim 3 wherein at least one microcube of said array has a projected area of about 1mm^2 or less.

5. The article of claim 4 wherein at least one microcube of said array has a projected area of about 0.35mm^2 or less.

6. The article of claim 5 wherein at least one microcube of said array has a projected area of about 0.04 - 0.12mm^2.

7. The article of claim 3 wherein said sheeting comprises a polymer resin.

8. The article of claim 7 wherein said polymer resin is selected from the group consisting of acrylic, polycarbonate, vinyl, polyester, and polyethylene.

9. The article of claim 7 wherein said microcubes are formed by embossing.

10. The article of claim 7 wherein said microcubes are formed by casting.

11. The article of claim 1 in which at least one microcube of said array is canted.

12. The article of claim 11 wherein the array is formed in a material having a refractive index n, and the cant of at least one microcube in said array does not exceed about $\tan^{-1}\sqrt{2} - \sin^{-1}(1/n)$.

13. An article of claim 11 comprising an array of microcubes, such that for every plane in space there are two adjacent microcubes for which at the place of adjacency none of the face edges is parallel to that plane, and in which at least one microcube of said array is rectangular or pentagonal, said at least one microcube of said array being canted face-more-parallel.

14. The article of claim 11 in which at least one microcube in said array is edge-more-parallel.

15. The article of claim 11 in which not all the cube axes in said array are parallel to each other.

16. The article of claim 15 in which some adjacent cubes are alternately face-more-parallel and edge-more-parallel.

17. The article of claim 14 wherein retroreflectance in the plane of symmetry of the microcubes of said array is substantially constant and is greater than about 50% for all entrance angles less than about 30°.

18. The article of claim 11 in which said array is a retroreflective part of a pavement marker.

19. An article comprising an array of microcubes, such that for every plane in space there are two adjacent microcubes for which at the place of adjacency none of the face edges is parallel to that plane, and in which a plurality of microcubes of said array are rectangular or pentagonal, said plurality of microcubes being canted face-more-parallel, at least one of said microcubes having a plane of symmetry in which lies the cube axis of said microcube, said face-more-parallel microcubes being present as paired microcubes or paired microcube arrays thereby increasing the entrance angularity both in the plane of symmetry and perpendicular to the plane of symmetry.

20. The article of claim 19 in which said article has a face for receiving incident light, and the retroreflector axis of said article is normal to said face.

21. An article of claim 19 comprising an array of microcubes, at least a portion of said array having substantially 100% active aperture for incidence angles of about 0°.

22. An article comprising an array of hexagonal microcubes, at least a portion of said array having substantially 100% active aperture at a predetermined angle of incidence.

23. An article comprising an array of contiguous microcubes, in which at least some of said contiguous microcubes are triangles, the shapes of which are such that

$$\cos(cant) \neq \frac{1}{\sqrt{3AB}}\left[1+\left(\sqrt{A}+\sqrt{B}\right)\sqrt{\frac{AB-1}{A+B}}\right]$$

where A and B are the tangents of two acute angles of the triangle.

24. An article comprising an array of triangular microcubes, the non-dihedral face-edges of each such microcube defining a plane, at least one of such defined planes being not parallel to at least one other such defined plane.

25. An article comprising paired rectangular microcubes.

26. An article comprising an array of rectangular microcubes, at least some of which have no dihedral face-edges collinear with any dihedral face-edges of any adjacent microcubes.

27. The article of claim 26 wherein said array comprises square subarrays of four adjacent square microcubes, wherein each microcube is rotated 90° with respect to an adjacent microcube.

28. An article comprising an array of pentagonal microcubes.

29. The article of claim 1 wherein said article is a master for use in the production of a tool for making a retroreflective article.

30. The article of claim 1 wherein said article is an electroform for use in the production of a tool for making a retroreflective article.

31. The article of claim 1 wherein said microcubes of said array are of unequal sizes.

32. The article of claim 3 wherein said sheeting is transilluminated.

33. A method of making an article having a pattern of hexagonal microcubes, the method comprising:

providing a plurality of about microthick plates, each plate having at least one end and one face,

placing said plates adjacent one another such that said ends of said plates lie substantially in a single plane;

providing in said plate ends a plurality of micro-sized substantially V-shaped grooves having polished surfaces, said groove surfaces defining an included groove angle for each said groove, said grooves having predetermined depth and width; and

displacing the adjacent plates with respect to one another so that the grooves on adjacent plates are offset from one another by about one half a groove width horizontally and greater than about one groove depth vertically, to form a pattern of hexagonal microcubes.

34. The method of claim 33 wherein the included groove angle is not constant along the length of a groove.

35. The method of claim 33 wherein the length of the side of each groove is not about equal to the thickness of each plate.

36. The method of claim 33 wherein the grooves are not substantially perpendicular to the faces of the plates.

37. A method of making an article having a pattern of rectangular microcubes, the method comprising

providing a plurality of about microthick plates, each plate having at least one end,

providing a bevel face on said end of each said plate,

providing a plurality of grooves on said ends of said plates substantially perpendicular to said bevel face to define a row of rectangular microcubes, and

arranging said plates in a pre-determined arrangement of rows of rectangular microcubes.

38. The method of claim 37 wherein the apices of said rectangular microcubes are all in one plane.

39. The method of claim 37 wherein the apices of said rectangular microcubes are not all in one plane.

40. The method of claim 37 wherein said plates are arranged so that adjacent plates are oriented 180° to each other.

41. The method of claim 37 wherein each said groove has two groove faces which intersect at a groove root, said bevel face has a lower edge, and said root of at least one said groove intersects the lower edge of said bevel face.

42. The method of claim 37 wherein said bevel face is provided along one edge of said end of each said plate.

43. A method of making an article having a pattern of rectangular microcubes comprising

providing a plurality of plates each plate having at least one end,

providing a first bevel face on each said end,

providing a first plurality of grooves on each said end substantially perpendicular to said first bevel face to define a first row of rectangular microcubes,

providing a second bevel face abutting said first bevel face on each said end,

providing a second plurality of grooves substantially perpendicular to said second bevel face to define a second row of rectangular microcubes, and

and arranging said plates in a pre-determined arrangement of rows of rectangular microcubes.

44. The method of claims 33, 37, or 43 wherein the included groove angle is not the same for each of said grooves.

45. The method of claims 33, 37, or 43 wherein said plates are each of substantially the same thickness.

46. The method of claims 33, 37, or 43 wherein said grooves are substantially parallel to one another.

47. The method of claims 33, 37 or 43 wherein said grooves have substantially flat faces.

48. The method of claims 33, 37, or 43 wherein said grooves are provided by cutting with a cutting tool and said plate ends are of a material capable of being simultaneously cut and polished by said cutting tool.

49. The method of claim 48 wherein said plate ends comprise electroless nickel.

50. The method of claim 48 wherein said plate ends comprise a rulable plastic.

51. The method of claims 33, 37, or 43 wherein the inside intersecting faces of at least one groove are of different lengths.

52. The method of claims 33, 37, or 43 wherein said grooves are provided by ruling with a cutting tool having an included angle, and wherein the included angle of the cutting tool is chosen smaller than the desired included angle of the groove and the desired included angle of the groove is obtained by tilting the cutting tool in accordance with the equation

$$e = \cos^{-1} [(\tan 0.5C)/\tan 0.5(C + \Delta C)]$$

where C is the included angle of the cutting tool, C + ΔC is the included angle of the groove, and e is the tilt of the cutting tool away from the vertical.

53. A method of making an article having a pattern of microcubes, said method comprising,

providing a plurality of plates of about micro-sized thickness, each such plate having two substantially parallel faces and at least one end therebetween,

providing a plurality of micro-sized polished grooves in the ends of the plates, each groove comprising at least one face and

positioning the plates adjacent one another in a pre-determined arrangement to define a desired pattern of hexagonal microcubes, said pattern comprising the faces of the grooves in the ends of the plates, the pre-determined arrangement of plates being determined by the plate thickness t, groove depth d, and the desired slip s between plates, the slip s being not equal to zero.

54. The method of claim 53 wherein during the step of providing said grooves, the plates are held at a pre-determined angle relative to the direction of said grooves, said pre-determined angle being not equal to 90°.

55. The method of claim 53, wherein during the step of providing said grooves, the plates are held at a pre-determined angle relative to the direction of said grooves, said pre-determined angle being not equal to 90°

56. The method of claim 53 wherein t, d, and s have values such that

$$0.5 \leq \frac{d + s}{t} \leq 1.2$$

57. The method of claim 56 wherein t, d and s have values such that

$$\frac{1}{\sqrt{2}} \leq \frac{d + s}{t} \leq 1$$

58. The method of claim 53 wherein the microcubes are rectangular and wherein the method includes the further step of providing a bevel face along one edge of said end of the plate.

59. The method of claim 58, wherein in said pre-determined arrangement, adjacent plates are rotated 180° with respect to one another.

60. The method of claim 53 wherein said microcubes are rectangular and wherein two rows of microcubes are formed on said end of each said plate, said method including the additional steps of

providing a first beveled face along about the midpoint of the thickness of said end, such that the microcubes of said first row each comprise a portion of said first bevel face and faces of two adjacent grooves,

providing a second bevel face along about the midpoint of the thickness of said end, and providing a second plurality of micro-sized grooves, such that the microcubes of said second row each comprise a portion of said second bevel face and faces of two adjacent grooves of said second plurality.

61. The method of claim 60 wherein said first and second bevel faces intersect at a given depth from said end, and wherein the depth of the grooves and the depth of the intersection of said first and second bevel faces are selected such that said resulting microcubes are square.

62. The method of claim 53 wherein said microcubes are square with rectilinear edges and said plurality of grooves comprises three sets of grooves, and wherein the grooves of said first set have a first included angle and are provided with said plates at a first tilt angle, the grooves of said second set have a second included angle and are provided with said plates at a second tilt angle, and the grooves of said third set have a third included angle and are provided with said plates at a third tilt angle.

63. The method of claim 62 wherein in said pre-determined arrangement adjacent plates are rotated 180° with respect to one another.

64. The method of claim 53 wherein said microcubes are pentagonal, and wherein

said plurality of plates is provided as a first plurality of plates and a second plurality of plates, each of said plates having one flat face and the opposite face having a plurality of parallel V-grooves, such that said end of each plate has a flat side and a grooved side,

each of said first plurality of plates is provided with a bevel face along the flat side of said end, and is provided with a plurality of grooves along the grooved side of said end,

each of said second plurality of plates is provided with a bevel face along the grooved side of said end, and is provided with a plurality of grooves along the flat side of said end, and

the plates are positioned adjacent one another in a predetermined arrangement such that pairs of oppositely oriented plates of said first plurality alternate with pairs of oppositely oriented plates of said second plurality.

65. The method of claim 64, wherein the V-grooves in the side faces of the plates have an included angle of g, where

$$g = 2 \arctan \frac{(\sqrt{3} \cos (v-u))}{(\cos (v) - \sqrt{2} \sin (v))}$$

and where v and u are the cants of the pentagonal microcubes of said first and second plurality of plates, respectively.

66. The method of claim 53 wherein said microcubes are hexagonal with pentagonal faces, and wherein said plurality of plates is provided with a plurality of V-grooves on the two opposing faces thereof, such that each said end has two grooved sides,

a first plurality of grooves being provided in each said end with said plate held in a first position,

a second plurality of grooves being provided in each said end with said plate held in a second position,

a third plurality of grooves being provided in each said end with said plate held in a third position, and

said plates being positioned with side grooves interlocking, thereby to define a pattern of hexagonal microcubes with pentagonal faces.

67. The method of claim 66 wherein said first plurality of grooves have an included angle of about 70.52° and said first position is substantially vertical, said second plurality of grooves have an included angle of about 131.81° and in said second position said plate is tilted about +50.77° from the vertical; and said third plurality of grooves have an included angle of about 131.81° and in said third position said plate is tilted about -50.77° from the vertical.

68. The method of claim 53 wherein said microcubes are triangular, wherein

said plates are held at a desired angle from the vertical,

three sets of parallel grooves are provided in said ends, each set of grooves having a predetermined included angle, and each set of grooves being at a predetermined angle with respect to said other two sets of parallel grooves, thereby to define a row of triangular microcubes on each said end, and

the plates are arranged with adjacent plates oppositely oriented.

69. The method of claim 68 wherein the predetermined included angle of each set of grooves is about 70.52° and each set of grooves is at an angle of about 60° with respect to the other two sets.

70. A method of making microthick plates for use in the manufacture of an article having microcubes, comprising

providing a substrate having a passive surface,

depositing on said passive surface a microthick layer of a material, and

separating said deposited material as a microthick plate from said substrate.

71. The method of claim 70 wherein said material is electroless nickel.

72. The method of claim 70 wherein said substrate is provided with undercuts and said deposited material extends into said undercuts, whereby said deposited material is retained on said substrate prior to separation therefrom.

73. The method of claim 72 wherein said deposited material is separated from said substrate by machining through said deposited layer in the vicinity of said undercuts.

74. The method of claim 72 wherein said passive surface is a polished surface.

75. The method of claim 74 wherein said polished surface of said substrate is replicated in said plate.

76. The method of claim 70 wherein said material is deposited to a desired thickness.

77. The method of claim 70 wherein said material is deposited to greater than a desired thickness and is then machined to said desired thickness.

78. The method of claim 77 wherein said material is provided with an optical surface as it is being machined to said desired thickness.

79. The method of claim 70 wherein said deposited material is polished.

80. The method of claim 70 wherein said passive surface of said substrate is grooved prior to the deposition of said layer of material thereon, whereby said grooved surface is replicated in said plate.

81. The method of claim 70 wherein said deposited material is provided with a plurality of grooves, whereby said plate is grooved on its two opposing faces.

82. The method of claim 70 wherein said deposited material is provided with a plurality of grooves.

83. The method of claim 70 further comprising the steps of

providing said deposited material with a plurality of grooves,

depositing on said grooved surface a second layer of material,

providing a second plurality of grooves on the surface of said second layer of material, and

separating said second layer of material from said first deposited material, such that said second layer of material is a plate being grooved on its two opposing faces.

84. The method of claim 83 wherein said first deposited material is passivated prior to the deposition of said second layer of material thereon.

85. A method of making plates for use in the manufacture of an article having microcubes, comprising,

providing a substrate having a surface,

depositing on said surface a layer of a material, and

slicing the substrate into microthick plates having the deposited layer on one end thereof.

86. The method of claim 85 wherein said deposited material is electroless nickel.

87. A microthick plate made in accordance with the method of claim 70.

88. A microthick plate made in accordance with the method of claim 85.

89. A microthick plate having two opposing surfaces and at least one end therebetween, said at least one end being provided with a plurality of microcube faces.

90. A microthick plate of claim 89 wherein said end comprises electroless nickel.

91. A pavement marker for establishing on a finished roadway surface a marking visible from an oncoming vehicle, said pavement marker comprising a base member adapted to be mounted on the finished roadway surface, and a retroreflective signal means, said retroreflective signal means comprising an array of microcubes of claim 1.

92. The pavement marker of claim 91 wherein the retroreflective signal means front surface is sloped about 30°-40° with respect to the road surface and comprises an array of canted rectangular microcubes, the cube axis cant being in the range of about -5° to -13°.

93. The pavement marker of claim 92 having horizontal entrance angularity up to at least about 30°.